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2N2710/FTSO2710 T-35-13

NPN Small Signal High Speed Low Power Saturating Switch Transistor

ABSOLUTE MAXIMUM RATINGS (Note 1)

PACKAGE

2N2710	TO-18
FTSO2710	TO-236AA/AB

Temperatures

Storage Temperature	-65° C to 200° C
Operating Junction Temperature	200° C

Power Dissipation (Notes 2 & 3)

	2N	FTSO
Total Dissipation at		
25° C Ambient Temperature	0.5 W	0.350 W*
25° C Case Temperature	1.2 W	

Voltages & Currents

V_{CEO}	Collector to Emitter Voltage (Note 4)	20 V
V_{CES}	Collector to Emitter Voltage	30 V
V_{CBO}	Collector to Base Voltage	40 V
V_{EBO}	Emitter to Base Voltage	5.0 V
I_C	Collector Current	500 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV_{CEO}	Collector to Emitter Breakdown Voltage	20		V	$I_C = 10$ mA, $I_B = 0$
BV_{CES}	Collector to Emitter Breakdown Voltage	30		V	$I_C = 10$ μA, $I_B = 0$
BV_{CBO}	Collector to Base Breakdown Voltage	40		V	$I_C = 10$ μA, $I_E = 0$
BV_{EBO}	Emitter to Base Breakdown Voltage	5.0		V	$I_E = 10$ μA, $I_C = 0$
I_{EBO}	Emitter Cutoff Current		1.0	μA	$V_{EB} = 3.0$ V, $I_C = 0$
I_{CBO}	Collector Cutoff Current (150° C)		30 30	nA μA	$V_{CB} = 20$ V, $I_E = 0$ $V_{CB} = 20$ V, $T_A = 150$° C
h_{FE}	DC Current Gain (Note 5)	40 40			$I_C = 10$ mA, $V_{CE} = 1.0$ V $I_C = 50$ mA, $V_{CE} = 1.0$ V
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage		0.25 0.40	V V	$I_C = 10$ mA, $I_B = 1.0$ mA $I_C = 50$ mA, $I_B = 5.0$ mA
$V_{BE(sat)}$	Base to Emitter Saturation Voltage		0.90 1.30	V V	$I_C = 10$ mA, $I_B = 1.0$ mA $I_C = 50$ mA, $I_B = 5.0$ mA

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 200° C and junction-to-case thermal resistance of 146° C/W (derating factor of 6.8 mW/° C); junction-to-ambient thermal resistance of 350° C/W (derating factor 2.8 mW/° C); (TO-236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length ≤ 300 μs; duty cycle ≤ 2%, and ≤ 1.2 ms pulse duration.
6. For product family characteristic curves, refer to Curve Set T162

* Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

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2N2904/5/6/7 PN2904/5/6/7 FTSO2904/5/6/7

T-37-17

PNP Small Signal General Purpose Amplifiers & Switches

- **V_{CEO} ... -40 V (Min)**
- **h_{FE} ... 40-120 (2N/PN/FTSO2904/6), 100-300 (2N/PN/FTSO2905/7)**
- **t_{on} ... 45 ns (Max) @ 150 mA, t_{off} ... 100 ns (Max) @ 150 mA**
- **Complements ... 2N/PN/FTSO2218 Series, 2N/PN/FTSO2218A Series**

PACKAGE

2N2904	TO-39
2N2905	TO-39
2N2906	TO-18
2N2907	TO-18
PN2904	TO-92
PN2905	TO-92
PN2906	TO-92
PN2907	TO-92
FTSO2904	TO-236AA/AB
FTSO2905	TO-236AA/AB
FTSO2906	TO-236AA/AB
FTSO2907	TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures	**2N**	**PN/FTSO**
Storage Temperature	-65° C to 200° C	-55° C to 150° C
Operating Junction Temperature	175° C	150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	**2N2904/5**	**2N2906/7**
25° C Ambient Temperature	0.6 W	0.4 W
25° C Case Temperature	3.0 W	1.8 W

Total Dissipation at	**PN**	**FTSO**
25° C Ambient Temperature	0.625 W	0.350 W*
25° C Case Temperature	1.0 W	

Voltages & Currents		**2N/PN2904**
V_{CEO}	Collector to Emitter Voltage (Note 4)	−40 V
V_{CBO}	Collector to Base Voltage	−60 V
V_{EBO}	Emitter to Base Voltage	−5.0 V
I_C	Collector Current	600 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	2N/PN2904/6 MIN	MAX		TEST CONDITIONS
h_{FE}	DC Current Gain (Note 5)	40	120		I_C = 150 mA, V_{CE} = −10 V
		20			I_C = 500 mA, V_{CE} = −10 V
		35			I_C = 10 mA, V_{CE} = −10 V
		25			I_C = 1.0 mA, V_{CE} = −10 V
		20			I_C = 0.1 mA, V_{CE} = −10 V

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 200° C and junction-to-case thermal resistance of 58 3° C/W (derating factor of 17.2 mW/° C); junction-to-ambient thermal resistance of 292° C/W (derating factor of 3 42 mW/° C) for 2N2904 and 2N2905; junction-to-case thermal resistance of 97.3° C/W (derating factor of 10.3 mW/° C); junction-to-ambient thermal resistance of 437° C/W (derating factor of 2.28 mW/° C) for the 2N2906 and 2N2907. These ratings give a maximum junction resistance of 150° C and junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C) for PN2904, PN2905, PN2906, and PN2907; (TO236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%
6. For product family characteristic curves, refer to Curve Set T212.

* Package mounted on 99.5% alumina 8mm x 8mm x 0.6mm.

2N2904/5/6/7
PN2904/5/6/7
FTSO2904/5/6/7

T-35-17

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	2N/PN2905/7 MIN	MAX		TEST CONDITIONS
h_{FE}	DC Current Gain (Note 5)	100 30 75 50 35	300		I_C = 150 mA, V_{CE} = −10 V I_C = 500 mA, V_{CE} = −10 V I_C = 10 mA, V_{CE} = −10 V I_C = 1.0 mA, V_{CE} = −10 V I_C = 0.1 mA, V_{CE} = −10 V
SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV_{EBO}	Emitter to Base Breakdown Voltage	−5.0		V	I_C = 0, I_E = 10 μA
BV_{CBO}	Collector to Base Breakdown Voltage	−60		V	I_C = 10 μA, I_E = 0
I_{CEX}	Collector Reverse Current		50	nA	V_{CE} = −30 V, V_{EB} = −0.5 V
I_{CBO}	Collector Cutoff Current		20 20	nA μA	V_{CB} = −50 V, I_E = 0 V_{CB} = −50 V, I_E = 0, T_A = 150° C
I_B	Base Current		50	nA	V_{CE} = −30 V, V_{EB} = −0.5 V
$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage (Notes 4 & 5)	−60		V	I_C = 10 mA (pulsed), I_B = 0
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		−0.4 −1.6	V V	I_C = 150 mA, I_B = 15 mA I_C = 500 mA, I_B = 50 mA
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 5)		−1.3 −2.6	V V	I_C = 150 mA, I_B = 15 mA I_C = 500 mA, I_B = 50 mA
C_{ob}	Output Capacitance		8.0	pF	V_{CB} = −10 V, I_E = 0, f = 100 kHz
C_{ib}	Emitter Transition Capacitance		30	pF	V_{EB} = −2.0 V, I_C = 0, f = 100 kHz
h_{fe}	High Frequency Current Gain	2.0			I_C = 50 mA, V_{CE} = −20 V, f = 100 MHz
t_d	Turn On Delay Time (test circuit no. 224)		10	ns	I_C = 150 mA, V_{CC} = −30 V, I_{B1} = 15 mA
t_r	Rise Time (test circuit no. 224)		40	ns	I_C = 150 mA, V_{CC} = −30 V, I_{B1} = I_{B2} = 15 mA
t_s	Storage Time (test circuit no. 225)		80	ns	I_C = 150 mA, V_{CC} = −6.0 V, I_{B1} = 15 mA
t_f	Fall Time (test circuit no. 225)		30	ns	I_C = 150 mA, V_{CC} = −6.0 V, I_{B1} = I_{B2} = 15 mA

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2N2904A/5A/6A/7A
PN2904A/5A/6A/7A
FTSO2904A/5A/6A/7A

T-35-17

PNP Small Signal General Purpose Amplifiers & Switches

- P_D ... 625 mW @ T_A = 25° C (PN Series)
- V_{CEO} ... -60 V (Min)
- h_{FE} ... 40-120 (2N/PN/FTSO2904A/6A), 100-300 (2N/PN/FTSO2905A/7A)
- t_{on} ... 45 ns (Max) @ 150 mA, t_{off} ... 100 ns (Max) @ 150 mA
- Complements ... 2N/PN/FTSO2218 Series, 2N/PN/FTSO2218A Series

PACKAGE

2N2904A	TO-39
2N2905A	TO-39
2N2906A	TO-18
2N2907A	TO-18
PN2904A	TO-92
PN2905A	TO-92
PN2906A	TO-92
PN2907A	TO-92
FTSO2904A	TO-236AA/AB
FTSO2905A	TO-236AA/AB
FTSO2906A	TO-236AA/AB
FTSO2907A	TO-236AA/AB

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures	**2N**	**PN/FTSO**
Storage Temperature	-65° C to 200° C	-55° C to 150° C
Operating Junction Temperature	175° C	150° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	**2N2904/5A**	**2N2906/7A**
25° C Ambient Temperature	0.6 W	0.4 W
25° C Case Temperature	3.0 W	1.8 W

Total Dissipation at	**PN**	**FTSO**
25° C Ambient Temperature	0.625 W	0.350 W*
25° C Case Temperature	1.0 W	

Voltages & Currents		**2N/PN**
V_{CEO}	Collector to Emitter Voltage (Note 4)	−40 V
V_{CBO}	Collector to Base Voltage	−60 V
V_{EBO}	Emitter to Base Voltage	−5.0 V
I_C	Collector Current	600 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	2904A/2906A MIN	2904A/2906A MAX	UNITS	TEST CONDITIONS
h_{FE}	DC Current Gain (Note 5)	40	120		I_C = 150 mA, V_{CE} = −10 V
		40			I_C = 500 mA, V_{CE} = −10 V
		40			I_C = 10 mA, V_{CE} = −10 V
		40			I_C = 1.0 mA, V_{CE} = −10 V
		40			I_C = 0.1 mA, V_{CE} = −10 V

NOTES:
1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 200° C and junction-to-case thermal resistance of 58.3° C/W (derating factor of 17.2 mW/° C); junction-to-ambient thermal resistance of 292° C/W (derating factor of 3.42 mW/° C) for 2N2904A and 2N2905A; junction-to-case thermal resistance of 97.3° C/W (derating factor of 10.3 mW/° C); junction-to-ambient thermal resistance of 437° C/W (derating factor of 2.28 mW/° C) for the 2N2906A and 2N2907A. These ratings give a maximum junction resistance of 150° C and junction-to-case thermal resistance of 125° C/W (derating factor of 8.0 mW/° C); junction-to-ambient thermal resistance of 200° C/W (derating factor of 5.0 mW/° C) for PN2904A, PN2905A, PN2906A, and PN2907A; (TO-236) junction-to-ambient thermal resistance of 357° C/W (derating factor of 2.8 mW/° C).
4. Rating refers to a high current point where collector to emitter voltage is lowest.
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. For product family characteristic curves, refer to Curve Set T212.

* Package mounted on 99.5% alumina 8 mm x 8 mm x 0.6 mm.

2N2904A/5A/6A/7A
PN2904A/5A/6A/7A
FTSO2904A/5A/6A/7A

T-35-17

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	2905A/2907A MIN	MAX	UNITS	TEST CONDITIONS
h_{FE}	DC Current Gain (Note 5)	100 50 100 100 75	300		I_C = 150 mA, V_{CE} = −10 V I_C = 500 mA, V_{CE} = −10 V I_C = 10 mA, V_{CE} = −10 V I_C = 1.0 mA, V_{CE} = −10 V I_C = 0.1 mA, V_{CE} = −10 V
BV_{EBO}	Emitter to Base Breakdown Voltage	−5.0		V	I_C = 0, I_E = 10 μA
BV_{CBO}	Collector to Base Breakdown Voltage	−60		V	I_C = 10 μA, I_E = 0
I_{CEX}	Collector Reverse Current		50	nA	V_{CE} = −30 V, V_{EB} = −0.5 V
I_{CBO}	Collector Cutoff Current		10 10	nA μA	V_{CB} = −50 V, I_E = 0 V_{CB} = −50 V, I_E = 0, T_A = 150° C
I_B	Base Current		50	nA	V_{CE} = −0 V, V_{EB} = −0.5 V
$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage (Notes 4 & 5)	−40		V	I_C = 10 mA (pulsed), I_B = 0
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5)		−0.4 −1.6	V V	I_C = 150 mA, I_B = 15 mA I_C = 500 mA, I_B = 50 mA
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 5)		−1.3 −2.6	V V	I_C = 150 mA, I_B = 15 mA I_C = 500 mA, I_B = 50 mA
C_{ob}	Output Capacitance		8.0	pF	V_{CB} = −10 V, I_E = 0, f = 100 kHz
C_{ib}	Emitter Transition Capacitance		30	pF	V_{EB} = −2.0 V, I_C = 0, f = 100 kHz
h_{fe}	High Frequency Current Gain	2.0			I_C = 50 mA, V_{CE} = −20 V, f = 100 MHz
t_d	Turn On Delay Time (test circuit no. 224)		10	ns	I_C = 150 mA, V_{CC} = −30 V, I_{B1} = 15 mA
t_r	Rise Time (test circuit no. 224)		40	ns	I_C = 150 mA, V_{CC} = −30 V, I_{B1} = I_{B2} = 15 mA
t_s	Storage Time (test circuit no. 225)		80	ns	I_C = 150 mA, V_{CC} = −6.0 V, I_{B1} = 15 mA
t_f	Fall Time (test circuit no. 225)		30	ns	I_C = 150 mA, V_{CC} = −6.0 V, I_{B1} = I_{B2} = 15 mA
t_{on}	Turn On Time (test circuit no. 224)		45	ns	I_C = 150 mA, V_{CC} = −3.0 V, I_{B1} = 15 mA
t_{off}	Turn Off Time (test circuit no. 225)		100	ns	I_C = 150 mA, V_{CC} = −6.0 V, I_{B1} = I_{B2} = 15 mA

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2N3019/2N3020

T-29-23

NPN Small Signal General Purpose Amplifiers

- V_{CEO} ... **80 V (Min)**
- $V_{CE(sat)}$ ... **0.5 V (Max) @ 500 mA**
- h_{FE} ... **100-300 @ 150 mA (2N3019), 50 (Min) @ 100 μA & 500 mA (2N3019)**
- **Complements ... 2N4031, 2N4033**

PACKAGE

2N3019	TO-5
2N3020	TO-5

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-65° to 200° C
Operating Junction Temperature	200° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	
25° C Ambient Temperature	0.8 W
25° C Case Temperature	5.0 W

Voltages & Currents

V_{CEO}	Collector to Emitter Voltage	80 V
V_{CB}	Collector to Base Voltage	140 V
V_{EB}	Emitter to Base Voltage	7.0 V
I_C	Collector Current	1.0 A

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 5)

SYMBOL	CHARACTERISTIC	3019 MIN	3019 MAX	3020 MIN	3020 MAX	UNITS	TEST CONDITIONS
BV_{CEO}	Collector to Emitter Breakdown Voltage (Note 4)	80		80		V	I_C = 30 mA, I_B = 0
BV_{CBO}	Collector to Base Breakdown Voltage	140		140		V	I_C = 100 μA, I_E = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	7.0		7.0		V	I_E = 100 μA, I_C = 0
I_{EBO}	Emitter Cutoff Current		10		10	nA	V_{EB} = 5.0 V, I_C = 0
I_{CBO}	Collector Cutoff Current		10 10		10 10	nA μA	V_{CB} = 90 V, I_E = 0 V_{CB} = 90 V, I_E = 0, T_A = 150° C
h_{FE}	DC Current Gain (Note 4)	50 90 100 40 50 15	 300 	30 40 40 30 15	100 120 120 100 		I_C = 0.1 mA, V_{CE} = 10 V I_C = 10 mA, V_{CE} = 10 V I_C = 150 mA, V_{CE} = 10 V I_C = 150 mA, V_{CE} = 10 V, T_A = −55° C I_C = 500 mA, V_{CE} = 10 V I_C = 1.0 A, V_{CE} = 10 V

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 200° C and junction-to-case thermal resistance of 35° C/W (derating factor of 28.6 mW/° C); junction-to-ambient thermal resistance of 217° C/W (derating factor of 4.6 mW/° C).
4. Pulse conditions: length ≤ 300 μs; duty cycle ≤ 1%.
5. For product family characteristic curves, refer to Curve Set T149.

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 5)

SYMBOL	CHARACTERISTIC	3019 MIN	3019 MAX	3020 MIN	3020 MAX	UNITS	TEST CONDITIONS
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 4)		0.2 0.5		0.2 0.5	V V	I_C = 150 mA, I_B = 15 mA I_C = 500 mA, I_B = 50 mA
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 4)		1.1		1.1	V	I_C = 150 mA, I_B = 15 mA
C_{ob}	Output Capacitance		12		12	pF	V_{CB} = 10 V, I_E = 0, f = 1.0 MHz
C_{ib}	Input Capacitance		60		60	pF	V_{EB} = 0.5 V, I_C = 0, f = 1.0 MHz
h_{fe}	Small Signal Current Gain	80	400	30	200		I_C = 1.0 mA, V_{CE} = 5.0 V, f = 1.0 kHz
h_{fe}	Current Gain Bandwidth Product	5.0		5.0			I_C = 50 mA, V_{CE} = 10 V, f = 20 MHz
$r_b'C_c$	Collector Base Time Constant		400		400	ps	I_C = 10 mA, V_{CE} = 10 V, f = 4.0 MHz
NF	Noise Figure		4.0			dB	I_C = 100 μA, V_{CE} = 10 V, f = 1.0 kHz, R_S = 10 kΩ

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2N3053

T-29-21

NPN Small Signal General Purpose Amplifier

- V_{CEO} ... **40 V (Min)**
- h_{FE} ... **50-250 @ 150 mA**
- f_T ... **100 MHz (Min) @ 50 mA**

PACKAGE

2N3053	TO-39

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-65° C to 200° C
Operating Junction Temperature	175° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at 25° C Case Temperature	5.0 W
Linear Derating Factor	28.6 mW/° C

Voltages & Currents

V_{CEO}	Collector to Emitter Voltage	40 V
V_{CBO}	Collector to Base Voltage	60 V
V_{EBO}	Emitter to Base Voltage	5.0 V
I_C	Collector Current (Continuous)	700 mA

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 5)

SYMBOL	CHARACTERISTIC	MIN	MAX	UNITS	TEST CONDITIONS
BV_{ECO}	Collector to Emitter Breakdown Voltage	40		V	I_C = 100 μA, I_E = 0
BV_{CER}	Collector to Emitter Breakdown Voltage	50		V	I_C = 100 μA, R_{BE} = 10Ω
BV_{CBO}	Collector to Base Breakdown Voltage	60		V	I_C = 100 μA, I_E = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	5.0		V	I_C = 0, I_E = 100 μA
I_{CEX}	Collector Cutoff Current		0.25	μA	V_{CE} = 30 V, $V_{EB(OFF)}$ = 1.5 V
I_{EBO}	Emitter to Base Cutoff Current		0.25	μA	V_{EB} = 4.0 V, I_C = 0
h_{FE}	DC Pulse Current Gain (Note 4)	25 50	 250		I_C = 150 mA, V_{CE} = 2.5 V I_C = 150 mA, V_{CE} = 10 V
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 4)		1.4	V	I_C = 150 mA, I_B = 1.5 mA
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 4)		1.7	V	I_C = 150 mA, I_B = 15 mA
$V_{BE(ON)}$	Base to Emitter "On" Voltage		1.7	V	I_C = 150 mA, V_{CE} = 2.5 V
C_{ob}	Output Capacitance		15	pF	V_{CB} = 10 V, I_E = 0, f = 140 kHz
C_{ib}	Input Capacitance		80	pF	V_{EB} = 0.5 V, I_C = 0, f = 140 kHz
h_{fe}	Current Gain Bandwidth Product	5.0			I_C = 50 mA, V_{CE} = 10 V, f = 20 MHz

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 200° C and junction-to-case thermal resistance of 35° C/W (derating factor of 28.6 mW/° C).
4. Pulse conditions: length = 300 μs; duty cycle = 2%.
5. For product family characteristic curves, refer to Curve Set T149.

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2N3107/2N3108 2N3109

T-29-21

NPN Small Signal General Purpose Amplifiers & Saturated Switches

- **V_{CEO} ... 40 V (Min) (2N3109), 60 V (Min) (2N3107/8)**
- **$V_{CE(sat)}$ ... 1.0 V (Max) @ 1.0 A**
- **h_{FE} ... 100-300 @ 150 mA (2N3107/9), 40 (Min) @ 500 mA (2N3107/9, 40 (Min) @ 500 mA (2N3107/9)**
- **t_{on} ... 200 ns (Max) @ 150 mA**
- **t_{off} ... 600 ns (Max) (2N3108), 1.0 μs (Max) (2N3107/9) @ 150 mA**
- **NF ... 7.0 dB (Max) @ 1.0 kHz**

PACKAGE

2N3107	TO-39
2N3108	TO-39
2N3109	TO-39

3

ABSOLUTE MAXIMUM RATINGS (Note 1)

Temperatures

Storage Temperature	-65° C to 200° C
Operating Junction Temperature	200° C

Power Dissipation (Notes 2 & 3)

Total Dissipation at	
25° C Ambient Temperature	0.8 W
25° C Case Temperature	5.0 W

Voltages & Currents	**3107/8**	**3109**
V_{CEO} Collector to Emitter Voltage (Note 4)	60 V	40 V
V_{CBO} Collector to Base Voltage	100 V	80 V
V_{EBO} Emitter to Base Voltage	7.0 V	7.0 V

ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 7)

SYMBOL	CHARACTERISTIC	3107/9 MIN	3107/9 MAX	3108 MIN	3108 MAX	UNITS	TEST CONDITIONS
BV_{CBO}	Collector to Base Breakdown Voltage (2N3107 only)	100				V	I_C = 100 μA, I_E = 0
	(2N3108 only)			100		V	I_C = 100 μA, I_E = 0
	(2N3109 only)	80				V	I_C = 100 μA, I_E = 0
BV_{EBO}	Emitter to Base Breakdown Voltage	7.0		7.0		V	I_E = 100 μA, I_C = 0
I_{EBO}	Emitter Cutoff Current		10		10	nA	V_{EB} = 5.0 V, I_C = 0
I_{CBO}	Collector Cutoff Current		10		10	μA	V_{CB} = 60 V, I_E = 0, T_A = 150° C
I_{CES}	Collector Reverse Current		10		10	nA	V_{CE} = 60 V, V_{EB} = 0

NOTES:

1. These ratings are limiting values above which the serviceability of any individual semiconductor device may be impaired.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
3. These ratings give a maximum junction temperature of 200° C and junction-to-case thermal resistance of 35° C/W (derating factor of 28.6 mW/° C); junction-to-ambient thermal resistance of 218° C/W (derating factor of 4 5 mW/° C).
4. Rating refers to a high current point where collector to emitter voltage is lowest
5. Pulse conditions: length = 300 μs; duty cycle = 1%.
6. Saturation voltage measured with 1/4" lead length.
7. For product family characteristic curves, refer to Curve Set T149.

2N3107/2N3108/2N3109

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ELECTRICAL CHARACTERISTICS (25° C Ambient Temperature unless otherwise noted) (Note 6)

SYMBOL	CHARACTERISTIC	3107/9 MIN	3107/9 MAX	3108 MIN	3108 MAX	UNITS	TEST CONDITIONS
h_{FE}	DC Pulse Current Gain (Note 5)	100 40 35 30	300	40 25 20 15	120		I_C = 150 mA, V_{CE} = 1.0 V I_C = 500 mA, V_{CE} = 10 V I_C = 0.1 mA, V_{CE} = 10 V I_C = 150 mA, V_{CE} = 10 V, T_A = −55° C
$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage (Notes 4 & 5) (2N3107) (2N3108) (2N3109)	60 40		60		V V V	I_C = 30 mA, I_B = 0 I_C = 30 mA, I_B = 0 I_C = 30 mA, I_B = 0
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage (Note 5) (Notes 5 & 6)		0.25 1.0		0.25 1.0	V V	I_C = 150 mA, I_B = 15 mA I_C = 1.0 A, I_B = 100 mA
$V_{BE(sat)}$	Base to Emitter Saturation Voltage (Note 5) (Notes 5 & 6)		1.1 2.0		1.1 2.0	V V	I_C = 150 mA, I_B = 15 mA I_C = 1.0 A, I_B = 100 mA
C_{ob}	Open Circuit Output Capacitance (2N3107) (2N3108) (2N3109)		20 25		 20 	pF pF pF	V_{CB} = 10 V, I_E = 0, f = 140 kHz V_{CB} = 10 V, I_E = 0, f = 140 kHz V_{CB} = 10 V, I_E = 0, f = 140 kHz
C_{ib}	Open Circuit Input Capacitance		80		80	pF	V_{EB} = 0.5 V, I_E = 0, f = 140 kHz
t_{on}	Turn On Time (test circuit no. 288)		200		200	ns	$I_C \approx$ 150 mA, $I_{B1} \approx$ 7.5 mA, $I_{B2} \approx$ 7.5 mA
t_{off}	Turn Off Time (test circuit no. 289)		1000		600	ns	$I_C \approx$ 150 mA, $I_{B1} \approx$ 7.5 mA, $I_{B2} \approx$ 7.5 mA